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(54) Transfer of data by telephone

(57) A system for transfer of data by telephone from a series of other locations 11 to a central location 12, and optionally additionally from the central location 12 to the other locations 11, has a data transmitting terminal 11 at each other location capable of transforming data on paper into electronic images. A data receiving terminal 12 at the central location receives the electronic images and a computer 12 interprets them and creates or adds to data files 14. The paper 10 may be a form with the data in boxes and blocks. The forms can be transmitted to the other locations and returned with data to the central location using the system. The paper may be marked for reference purposes.

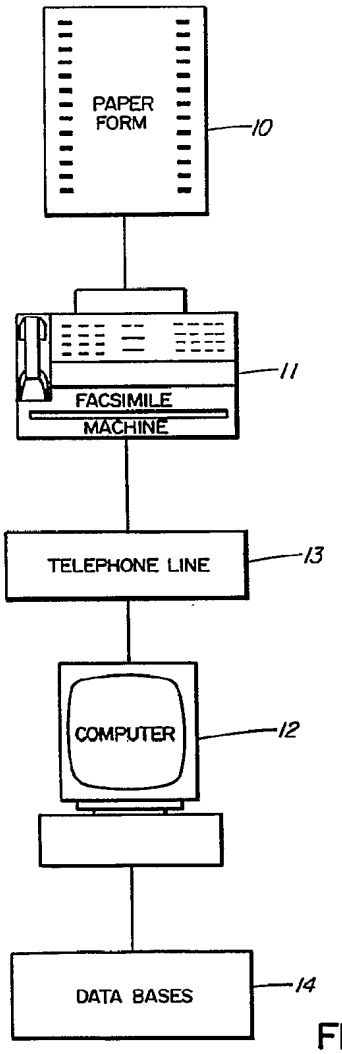

FIG. 1

GB 2 255 473 A

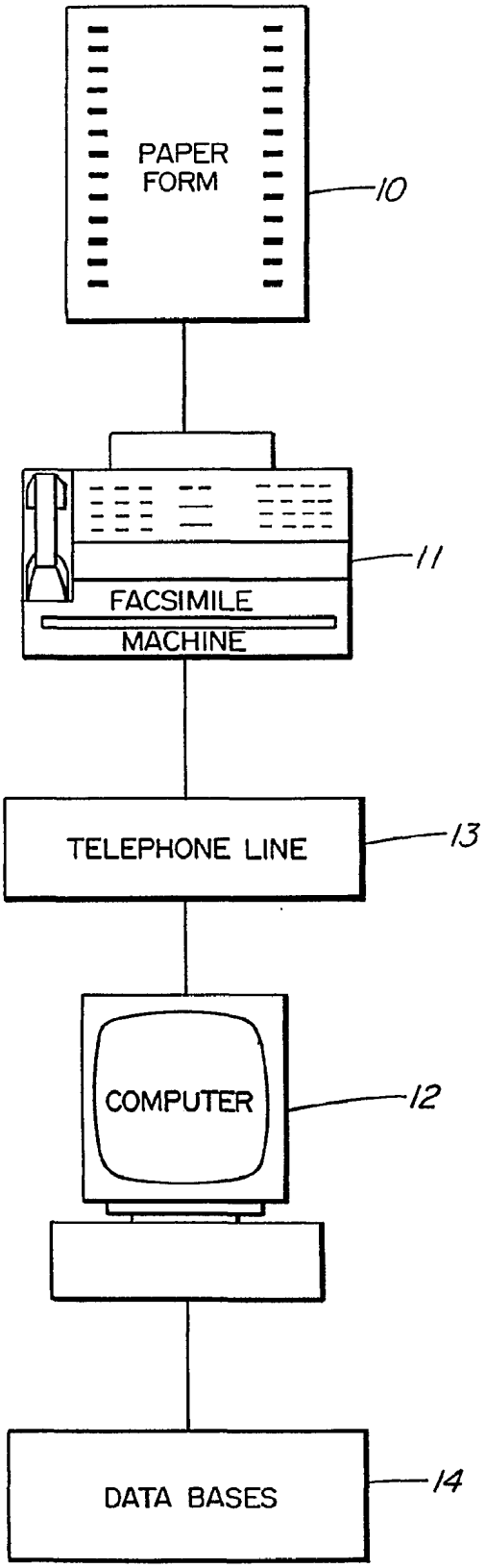
PAPER FORM
10
FACSIMILE MACHINE
11
TELEPHONE LINE
13
COMPUTER
12
DATA BASES
14

FIG. 1

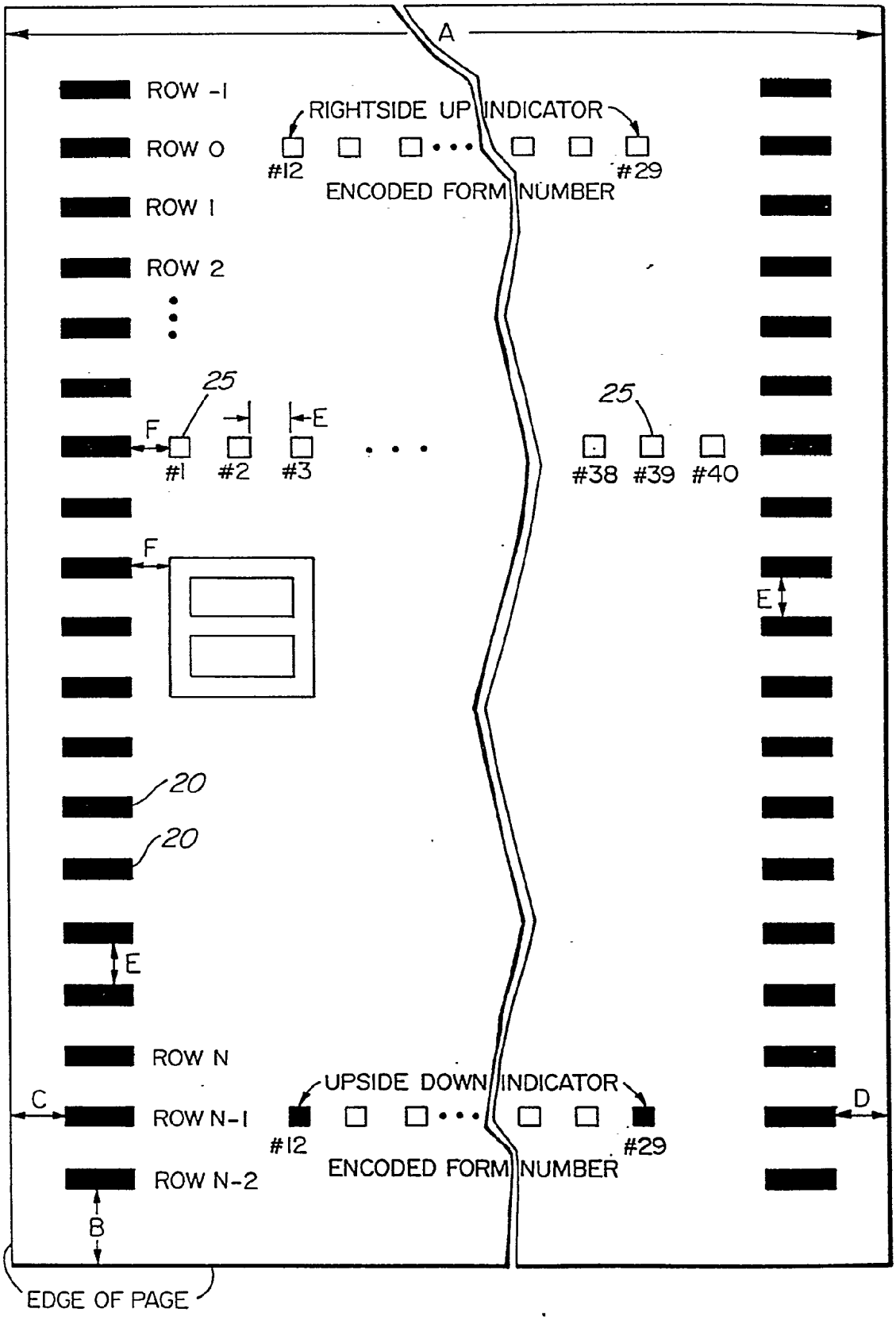

FIG. 2 (NOT DRAWN TO SCALE)

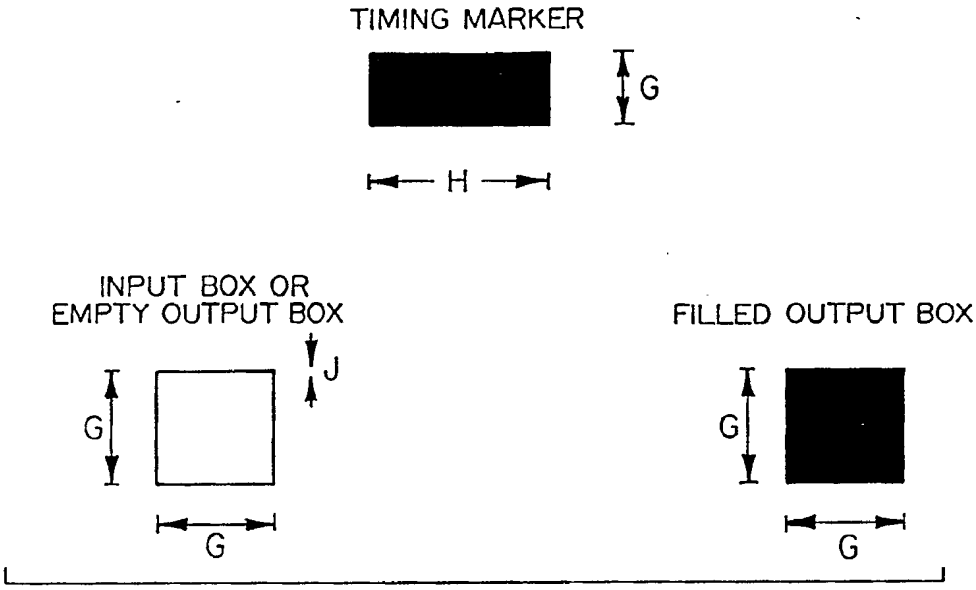
TIMING MARKER
G
H
INPUT BOX OR
EMPTY OUTPUT BOX
J
G
G
FILLED OUTPUT BOX
G
G

FIG. 3

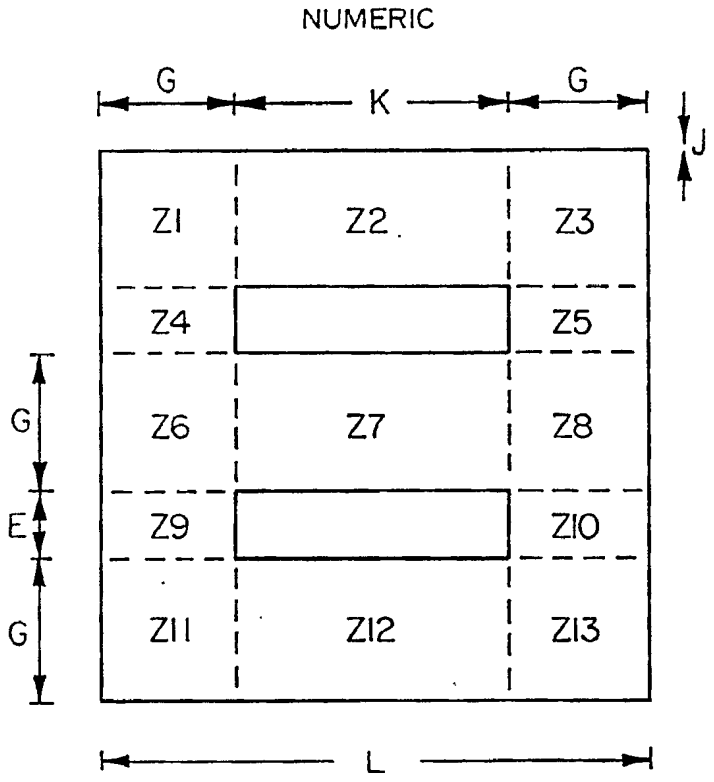
NUMERIC
G
K
G
J
Z1
Z2
Z3
Z4
Z5
Z6
Z7
Z8
Z9
Z10
Z11
Z12
Z13
G
E
G
L

FIG. 4

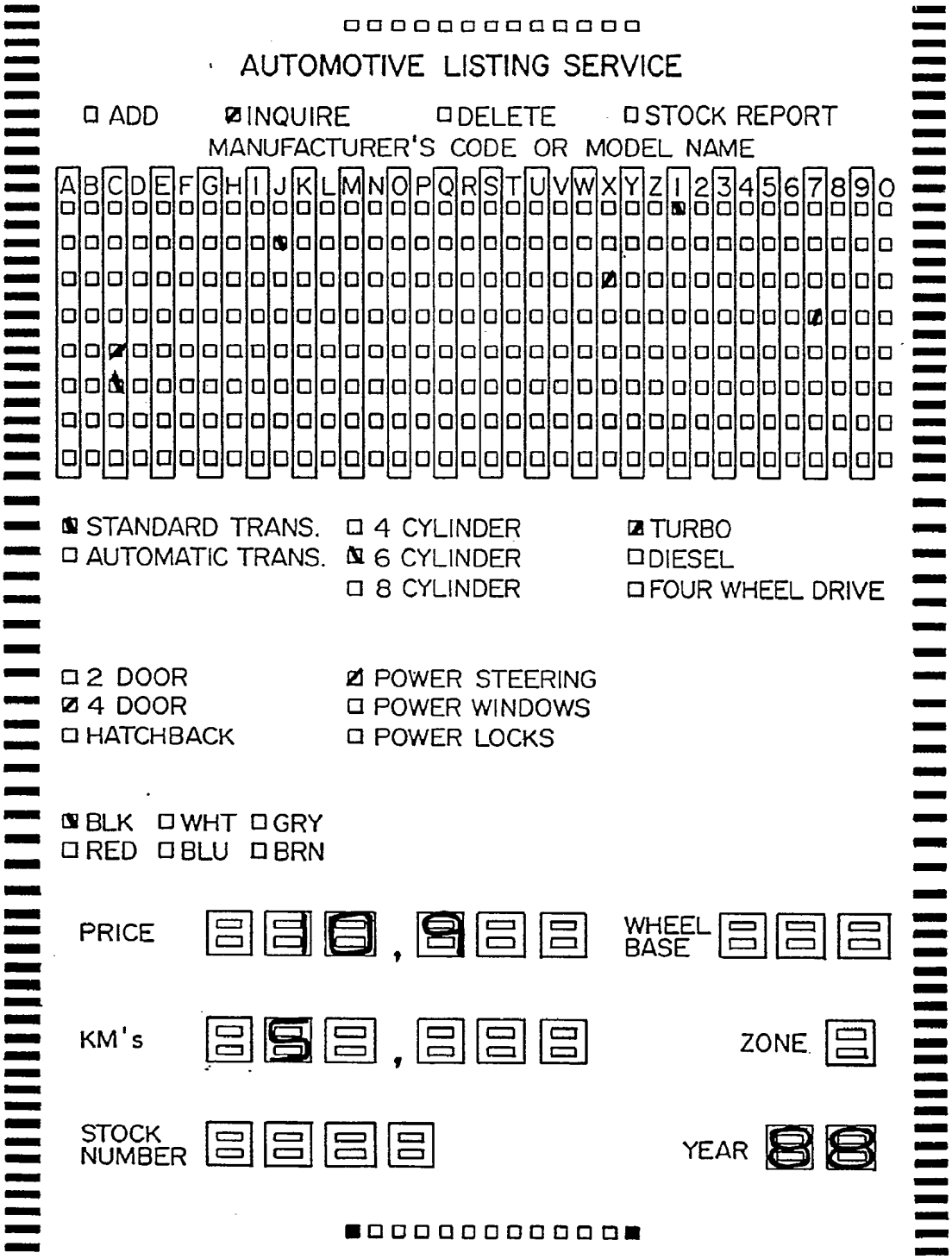
AUTOMOTIVE LISTING SERVICE
ADD
INQUIRE
DELETE
STOCK REPORT
MANUFACTURER'S CODE OR MODEL NAME
A B C D E F G H I J K L M N O P Q R S T U V W X Y Z 1 2 3 4 5 6 7 8 9 0
STANDARD TRANS.
AUTOMATIC TRANS.
4 CYLINDER
6 CYLINDER
8 CYLINDER
TURBO
DIESEL
FOUR WHEEL DRIVE
2 DOOR
4 DOOR
HATCHBACK
POWER STEERING
POWER WINDOWS
POWER LOCKS
BLK WHT GRY
RED BLU BRN
PRICE
WHEEL BASE
KM's
ZONE
STOCK NUMBER
YEAR

FIG. 5

AUTOMATED TELEPHONIC DATA TRANSFER SYSTEM

The invention relates to a system for the automated transfer of data, and more specifically, to a system in which telephonic transmissions provide the interface between a paper form carrying information and a computer capable of interpreting that information.

Devices for transmitting copies of documents over telephone lines, commonly called 'facsimile machines', are gaining in popularity. Unlike 'modems', which allow communication by phone line of text only, facsimile machines provide a means for phone transmission of both text and graphics. A facsimile machine creates an electronic image from a two-dimensional pictorial paper image, which may be solely text or may be text plus graphics, and transmits that electronic image to another facsimile machine which then recreates the pictorial image. Recently, a 'facsimile board' has become available for personal computers. When equipped with such a board, a computer is able to form an image in its memory of a pictorial image fed into a facsimile machine at another location. A pictorial image can be created on the computer screen from the memory contents, the computer user thereby seeing a copy of the pictorial image fed into the facsimile machine at the other location.

While the opportunity for a computer user to see almost instantaneously a copy of the pictorial images on a paper form fed into a facsimile machine at another location is very useful, an even more useful advance would be a system that allowed a computer to automatically interpret the images contained on the paper form and make use of information in those images. This invention relates to such an automated telephonic data transfer system.

The system to be described has the further advantages that it compensates for fluctuations in the rate at which the paper form is fed into the transmitting facsimile machine, and is capable of differentiating between the top and bottom of a paper form and between a series of such forms. By use of threshold recognition standards, the sy-

stem also protects against transmission errors caused by such factors as dust on the scanning optics of a transmitting facsimile machine.

The system of the invention allows for automated transfer of data by telephone between a central location and a series of other locations. It comprises a telephonic data transmitting terminal at each of the other locations, each transmitting terminal being capable of transforming data on a paper form having a specified format into transmittable electronic images. It further comprises a telephonic data receiving terminal at the central location, the receiving terminal being adapted to receive the electronic images. The system still further comprises a computer adapted to be connected to the receiving terminal and capable of interpreting the electronic images received by the receiving terminal based on a knowledge of the specified format on the paper form.

The computer may also be capable of creating data files from the interpreted electronic images, the data files having a content corresponding to the data on the paper form. The computer may additionally be capable of using the content of the data files to continuously update a series of internal data bases.

The specified format for the paper form may be generated by the computer. If each of the telephonic data transmitting terminals also has a receiving capability and the telephonic data receiving terminal also has a transmitting capability, i.e. standard 'facsimile' machines are utilized for the terminals, the specified format for the paper may be transmitted from the receiving terminal to each of the transmitting terminals. Also, at least some of the other locations may be capable of accessing data in the series of data bases in the computer through their respective receiving terminals.

Each paper form may have a pair of first markings, each first marking extending along a respective opposite edge of the paper parallel to the direction in which the paper form is adapted to be fed into the transmitting

terminal. The pair of first markings are utilized by the computer as a frame of reference for compensating for any fluctuations in the rate at which the paper form is fed into a transmitting terminal. Additionally, each paper form may have a pair of second markings, each second marking extending along a respective opposite end of the paper normal to the direction in which the paper form is adapted to be fed into the transmitting terminal. The pair of second markings are utilized by the computer to differentiate between the top and bottom of each paper form and to differentiate between a sequence of such forms.

The invention is also a process for transferring data to a central location having a telephonic data receiving terminal from a series of other locations each having a telephonic data transmitting terminal. The process comprises the steps of, firstly, preparing multiple copies of a paper form having a specified format. The second step consists of distributing at least one copy of the paper form to each of the other locations. The third step consists of receiving on the receiving terminal electronic images of data on the paper form fed into a transmitting terminal. The fourth step consists of interpreting the received electronic images by means of a computer connected to the receiving terminal and having knowledge of the specified format on the paper form in use at the other locations. The specified format for the paper form used in the first step may be prepared by the computer connected to the receiving terminal for interpreting the electronic images in the fourth step.

The system of the invention will next be described in greater detail by means of a preferred embodiment, utilizing the accompanying drawings, in which:

Figure 1 is a schematic illustration of the data flow path in the system of the preferred embodiment;

Figure 2 is an illustration of a format on a paper form of the preferred embodiment;

Figure 3 is an illustration of a timing marker, an empty output box and a filled output box, all of which

form part of the format on the paper form of the preferred embodiment.

Figure 4 is an illustration of a numeric character that forms part of the format on the paper form of the preferred embodiment.

Figure 5 is a schematic illustration of a format on a paper form used for an automotive listing service.

A general description of the invention will be provided with reference to Figure 1. A paper form 10 is fed into a facsimile machine 11 at a location removed from a computer 12 having mounted internally a facsimile board (not shown). Facsimile machine 11 is connected to the facsimile board in computer 12 by a telephone line 13, and when a telephone connection is made between the two, an image is created in the memory of computer 12 of the pictorial image on the face of paper form 10. The pictorial image on paper form 10 has a specified format comprising a series of multiple-choice boxes from which a user has made selections. Computer 12 previously generated the specified format for paper form 10, and that same software program knows how to interpret the image created in memory when a copy of a completed paper form 10 is received. The information retrieved from the memory image of paper form 10 may be data which can be used by the computer program to update data bases 14 in the computer, or that information may be commands which lead the computer to take further action. For instance, the system would be applicable to a branch store that wished to send information on its current inventory to its head office, but would also allow the branch store to query head office as to the availability of certain items. The system allows a computer at the head office to both receive and transmit information without using the time of the head office personnel. The system requires only that each branch store have a facsimile machine.

The general format of the paper form 10 will next be explained with reference to Figure 2. That general format, with the addition of extra format specific to the par-

ticular application, is generated by the computer. After being created on the screen of the computer, the complete format is either produced on a paper form which is mailed or otherwise transmitted to other locations connected to the system, or the complete format is simply transmitted through the facsimile board of the computer and the paper form is produced by the facsimile machine at each of the other locations.

The general format consists of a series of timing markers 20 each extending along a respective opposite edge of the paper form parallel to the direction in which the paper form is adapted to be fed into the facsimile machine, as shown in Figure 2. The number of rows of timing markers depends upon the length of the paper form being analyzed; for our purposes, those rows are numbered '-1' to 'N+2'. Inline with the pair of Row 0 timing markers are 18 empty boxes, and inline with the pair of Row N+1 timing markers are another 18 boxes. The outer pair of these boxes are left unfilled as a Rightside Up Indicator, but are filled as an Upside Down Indicator. The 16 boxes internal of each outer pair of boxes is the Encoded Form Number; these boxes contain a digital representation of the number identifying the form. As an example, when the computer program senses the 18 boxes on the leading edge of a paper form fed into a facsimile machine to be 1 0000 0000 0000 0101 1, the program knows that form 5 has been entered into the machine and that that form is upside down. In interpreting the information on the memory page created from the form, the program is able to compensate for the form being received upside down. The space extending between the pair of timing markers in Row 1 and the pair of timing markers in Row N is the space available on the paper form for the specific application format.

The computer program used in the system uses a graphical standard for information storage in digital form called 'PCX/DCX'. The use of PCX/DCX format makes it possible to address areas of a memory page such that points on the page appear either as 'on' (white) or 'off' (black)

squares, also known as 'pixels'. A facsimile page received through a facsimile board internal of the computer (or as an electronic output from a facsimile machine which is adjacent the computer) is stored in the memory of the computer as a grid of squares. That grid is 1728 units in width and has a length dependent on the chosen length of the paper form, i.e. 2200 units in length for a standard 8.5-inch by 11-inch form. Each square contains a value which signifies if it is black or white, and the computer program analyzes this grid to determine what information is stored on the memory page. With respect to the alphabetical lettering of dimensions shown in Figures 2, 3 and 4, the following values are used:

A =	1728 units	G =	22 units
B =	165 units	H =	50 units
C =	129 units	J =	1 unit
D =	128 units	K =	44 units
E =	11 units	L =	88 units
F =	31 units		

Each timing marker is 50 units wide and 22 units high. Each input box is 22 units wide and 22 units high on the outside and is 20 units wide and 20 units high on the inside, the lines forming the box being 1 unit wide. The left edge of the left column of timing markers is indented 129 units from the left edge of the memory page, and the right edge of the right column of timing markers is indented 128 units from the right edge of the memory page; this indentation is provided to accommodate for clipping of any paper forms that may be fed into a facsimile machine at an angle. The first and last timing markers on each memory page are spaced 165 units from the top and bottom edges of the page respectively.

Once the pictorial image on a paper form fed into a facsimile machine at a remote location has been turned into a memory page in the computer's memory using the PCX/DCX format, scanning of the memory page commences. The

program searches for the first pair of timing markers 165 units from the top of the memory page. A sample 3 units by 3 units is taken, and a determination made as to what number of the 9 square units are black. If more than a threshold value (based on normal noise experienced by facsimile machines) is black, further testing is performed to see if this black area may be a timing marker. If the threshold value is not met, the program continues scanning to the right in 0.125-inch increments until 0.25 of the width of the memory page has been scanned, at which time scanning commences at the left edge of the page at a position 0.05-inches further down the page. If no black area qualifies as a timing marker in the first four inches of the memory page, further searching is aborted and a determination is reached that the paper form image cannot be processed. The program does not allow for any marking between the pair of timing markers in either row -1 or row N+2, and tolerates only light stray marking between either of those pairs of timing markers and the proximate edge of the memory page.

Once a potential timing marker has been located, the program determines the dimensions of that object and compares them to the size a timing marker should have, i.e. 50 units width and 22 units height. If the object is close to that size, within guidelines set in the program, it is accepted as the first timing marker. Scanning of the page then proceeds to identify further timing markers, which are set 11 units apart down the page. Between the second set of timing markers is the Encoded Form Number surrounded by either the Rightside Up Indicators or the Upside Down Indicators --- if the latter is encountered, the program automatically recognizes that it is viewing the particular page from the bottom first, i.e. the paper form was fed upside down into the facsimile machine at the remote location.

The format described thus far is the 'general format', which is the common portion of the total format on paper forms. The program automatically generates the general format during creation of each new paper form format, and then looks for that format on the images of paper forms

transmitted by telephone back to the computer; however, the specific format on each paper form varies with the needs of the user at the remote location. The space available for the specific format on each paper form, henceforth called 'the free space', is the space between the inside of the columns of timing markers in rows 1 to N; that space is 40 columns wide and up to 120 lines long.

There are 3 types of information which can appear in the free space: (i) options, (ii) specifics, and (iii) numerics, which are all shown in the sample paper form format of Figure 5. With respect to that format, the first row of options underneath AUTOMOTIVE LISTING SERVICE are ADD, INQUIRE, DELETE and STOCK REPORT. At the time that the image for this paper form was created on the screen of the computer, the computer operator typed the four labels ADD, INQUIRE, DELETE and STOCK REPORT and drew an empty box beside each; the position of each label and associated box was then stored in a data base of the program. Similarly, under MANUFACTURER'S CODE OR MODEL NAME, an alphanumeric block was created by the computer operator for transferring alphanumeric data up to 8 characters in length. Next follow another series of options, i.e. 4 cylinders, 6 cylinders, 8 cylinders. A final area on the paper form contains numerics; a numeric is a figure-8 having its horizontal segments inline with timing markers and having its vertical segments inline with columns, as illustrated in Figure 2. When the image for the paper form for the AUTOMOTIVE LISTING SERVICE was stored by the computer, the relative position of each of the figure-8's was retained. Once a completed copy of the paper form was received back from the remote location, the program was able to interpret filled figure-8's as numerical data.

Once the paper form image has been created by a computer operator and assigned an Encoded Form Number for storage in the computer's library and transmitted to a series of remote locations either electronically or physically (if a paper form is printed at the computer location from the image), the form is completed at each remote

location and then returned by facsimile transmission to the computer. Without human intervention, the computer uses the timing markers on the memory page created from the facsimile transmission to orient itself relative to that page. The program then matches the Encoded Form Number on that memory page with the matching format in its library of stored specific formats. The program then utilizes the template of the particular stored format to interpret the information on the memory page. Variances in the separation distance of adjacent timing markers bordering the free space, caused for instance by fluctuations in the paper form feed speed into the facsimile machine at the remote location, are compensated by the program, which uses each pair of timing markers as a reference for the line of specific format stored between that pair in the template. The information interpreted from the memory page may be data which is turned into an ASCII file, or it may take the form of a command to the computer from a user of the facsimile machine at the remote location, for instance, asking the computer to send that user information on the contents of one of the computer's files. With respect to the ASCII data files produced, the computer may be programmed to periodically examine the content of those files and to use those contents to update a series of internal data bases.

As previously mentioned, the free space used for the specific format is 40 columns wide and up to 120 rows long (the number of rows depending on the length of the paper form selected). Figure 2 (which is not to drawn to scale) shows the position of the 40 available boxes, each designated as 25, in each row, those boxes being labelled #1 to #40. The 4 boxes next to the words ADD, INQUIRE, DELETE and STOCK REPORT in Figure 5, as well as the 36 boxes in each of the eight rows of the alphanumeric block entitled MANUFACTURER'S CODE OR MODEL NAME in Figure 5, have positions that would correspond to some of the box positions in Figure 2. Each box 25 has the outside dimensions of the input box shown in Figure 3, namely, 22 units by 22 units, and the borders of each box are defined by a line 1 unit

wide. Each row of boxes is in line with a pair of timing markers, and each of the outermost boxes are spaced 31 units from the adjacent timing marker; each box is spaced from each adjacent box by 11 units. The program knows the centre location of each of these boxes and examines a 15-unit by 15-unit area surrounding that centre location; if that area is more than 35% filled with black, the box is considered by the program to have been filled in. Any figure-8's created by the program for a paper form have the relative orientation relative to the box positions and timing marker positions as shown in Figure 2 --- the three horizontal segments of the figure-8 are each inline with a row of the timing markers, and the vertical segments are inline with box positions once removed from each other. Up to 13 figure-8's can be positioned in a row if the spacing between each figure-8 is maintained at 11 units and the end figure-8's are positioned 31 units from the adjacent timing markers.

There are two phases involved with decoding a numeric. Firstly, the numeric is scanned to determine what shape has been filled in, and secondly, the shape is identified as a known digit or rejected as nonsense. To determine what shape has been filled in, the program examines 13 locations inside each figure-8 for lines. If a piece of a line is present, that location is flagged as being filled. The locations marked as filled are then used to determine the pattern present. As with the boxes, the first step for each figure-8 is to locate the centre of 13 zones, designated as Z1 to Z13 in Figure 4. Zones Z1-Z3, Z6-Z8, and Z11-Z13 are treated exactly the same as for the boxes of the options and specifics. Zones Z4, Z5, Z9 and Z10 do not fall in a direct line between a pair of timing markers; in fact, those zones fall in a direct line between the spaces that separate pairs of timing markers. Thus the center of zones Z4, Z5, Z9 and Z10 is determined by averaging the 'x' and 'y' co-ordinates of the timing markers above and below those zones. For zones Z2, Z7 and Z12, the program looks vertically through each zone at three horizontally spaced

locations; for each zone, if a contiguous set of white points greater than a threshold length is found in two of the spaced locations, the program concludes that no horizontal line extends through that zone. For zones Z4, Z5, Z9 and Z10 the same process is used except that the line of points tested is horizontal rather than vertical. Each of zones Z1, Z3, Z6, Z8, Z11 and Z13 are tested in a similar way, except that only two lines of points are examined in each zone --- those two lines forming an 'X' crossing at the centre of the zone. Once the pattern has been determined, it is compared to a table of known patterns for the various numbers between 0 and 9. Each comparison is given a score reflecting how closely it matches the known pattern. The highest score is used to decide which digit the pattern actually represents. This method of pattern matching allows a certain amount of variance in what shapes are recognized as digits. For instance, some people add a curl to their 9's while others don't. The algorithm which performs the comparison assigns various weights to different sections of the figure-8; some pieces of numbers are more important than others. A certain correspondence threshold must be met before the program recognizes the contents of a figure-8 to be a number. If the contents may match two numbers equally well, the program will not indicate a match with either number.

Once the program has scanned the contents of the free space, it reads the Encoded Form Number and the Upside Down Indicators (Rightside Up Indicators, if the form was fed into the facsimile machine upside down) at the bottom end of the memory page. It compares that information with the Encoded Form Number and Indicators that it scanned at the top end of the memory page. If the two pieces of information do not match (because, for instance, a piece of dust has obstructed the facsimile machine's scanner), the program indicates a mismatch and sends a signal to the facsimile machine at the remote location indicating that the copy of the paper form was not properly received.

Following as a series of five appendices are the

six subprograms (called 'I-Fax programs') which comprise the computer program described above. The six subprograms are: (1) Fax.H, (2) FaxDir.H, (3) FaxProc, (4) FaxDes, (5) FaxSend, and (6) Fax2Pcx. The subprogram Fax.H defines all the constants, variables, and functions needed by other subprograms. The subprogram FaxDir.H allows any of the subprograms to locate their 'home directory' which holds their .EXE and support files. Appendix A contains the source code for the subprograms Fax.H and FaxDir.H. Appendix B contains a description of the subprogram FaxProc, followed by a series of six flow charts and the source code for that subprogram. Appendix C contains a description of the subprogram FaxDes, followed by a series of five flow charts and the source code for that subprogram. Appendix D contains a description of the subprogram FaxSend, followed by a series of three flow charts and the source code for that subprogram. Appendix E contains a description of the subprogram Fax2Pcx, followed by a series of three flow charts and the source code for that subprogram.

CLAIMS

1. A system for the automated transfer of data by telephone between a central location and a series of other locations, the system comprising:

(a) a telephonic data transmitting terminal at each of the other locations, each transmitting terminal being capable of transforming data on a paper form having a specified format into transmittable electronic images;

(b) a telephonic data receiving terminal at the central location adapted to receive the electronic images; and,

(c) a computer adapted to be connected to the telephonic data receiving terminal, the computer being capable of interpreting the electronic images received by the receiving terminal based on a knowledge of the specified format on the paper form, the computer being further capable of creating data files from the interpreted electronic images, the data files having a content corresponding to the data on the paper form.

2. An automated data transfer system as in claim 1, wherein the computer is also capable of using the content of the data files to continuously update a series of internal data bases.

3. An automated data transfer system as in claim 1, wherein the specified format for the paper form is generated by the computer.

4. An automated data transfer system as in claim 1, wherein each of the telephonic data transmitting terminals also has a receiving capability and wherein the telephonic data receiving terminal also has a transmitting capability, and wherein the specified format for the paper form may be transmitted from the receiving terminal to each of the transmitting terminals.

5. An automated data transfer system as in claim 2, wherein each of the telephonic data transmitting terminals also has a receiving capability and wherein the telephonic data receiving terminal also has a transmitting

capability, and wherein at least some of the series of other locations are capable of accessing data in the series of data bases in the computer through their respective receiving terminals.

6. An automated data transfer system as in claim 1, wherein each paper form has a pair of first markings, each first marking extending along a respective opposite edge of the paper form parallel to the direction in which the paper form is adapted to be fed into the transmitting terminal, the pair of first markings being utilized by the computer as a frame of reference for compensating for any fluctuations in the rate at which the paper form is fed into a transmitting terminal.

7. An automated data transfer system as in claim 6, wherein each paper form also has a pair of second markings, each second marking extending along a respective opposite end of the paper form normal to the direction in which the paper form is adapted to be fed into the transmitting terminal, the pair of second markings being utilized by the computer to differentiate between the top and bottom of each paper form and to differentiate between a series of such forms.

8. A process for transferring data to a central location having a telephonic data receiving terminal from a series of other locations each having a telephonic data transmitting terminal, the process comprising the steps of:

(a) preparing multiple copies of a paper form having a specified format;

(b) distributing at least one copy of the paper form to each of the other locations;

(c) receiving on the receiving terminal at the central location electronic images of data on the paper form fed into the transmitting terminals at any of the other locations;

(d) interpreting the received electronic images by means of a computer connected to that receiving terminal and having knowledge of the specified format on the paper form at the other locations; and,

(e) creating data files from the interpreted electronic images by means of the computer.

9. A process as in claim 8, wherein the specified format for the paper form used in step (a) is prepared by the computer connected to the receiving terminal for interpreting the electronic images in step (d).

10. A process as in claim 8 or 9, wherein each of the telephonic data transmitting terminals also has a receiving capability and wherein the telephonic data reception terminal also has a transmitting capability, and wherein the distribution of the paper form in step (b) is performed by transmitting a copy of the paper form from the receiving terminal to each of the transmitting terminals.

Patents Act 1977
Examiner's report to the Comptroller under Section 17 (The Search Report)

Application number
9203506.2

Relevant Technical fields

(i) UK Cl (Edition K) H4K (KOD2,KOD4,KOD8)
H4F (FDB,FRX)

(ii) Int Cl (Edition 5) H04M 11/00,11/06,11/08;
H04N 1/32

Search Examiner
G N CHAPMAN

Databases (see over)

(i) UK Patent Office

(ii) ONLINE DATABASES: WPI

Date of Search
21 MAY 1992

Documents considered relevant following a search in respect of claims 1 TO 10

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
A	GB 2211698 A (AT & T) - Note Figure 1	
A	GB 2195863 A (DICTAPHONE) - Note Figure 1	

wl - c:\wp51\doc99\fil000786

Category	Identity of document and relevant passages	Relevant to claim(s)

Categories of documents

X: Document indicating lack of novelty or of inventive step.

Y: Document indicating lack of inventive step if combined with one or more other documents of the same category.

A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family, corresponding document.

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